POPULATION OF TETRANEUTRON CONTINUUM IN REACTIONS OF ^{8}He ON DEUTERIUM

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The search for the the multineutron systems is old, but still unsettled problem of the low-energy nuclear physics. Numerous attempts of search for the existence of the tetraneutron as a bound or resonant state have been realized using multiple approaches (e.g. uranium fission reactions, pion-induced double-chargeexchange and transfer reactions). However, no certain evidence of tetraneutron existence have bee obtained.

The situation has changed with the recent studies of 4n population in reactions with ^{8}He, where four neutrons can be found in a spatially-separated neutron-halo configuration. The result of the recent ^{1}H(^{8}He,p α) experiment [1] showed the observation of the "resonance-like structure" at E(4n) = 2.37 MeV with Γ = 1.75 MeV.

The high intensity ^{8}He secondary beam with energy 26 AMeV, produced at the recently commissioned ACCULINNA2 fragment separator [2], was used for the population of the tetraneutron in the ^{8}He+d interaction. The detection the low-energy recoils ^{6}Li and ^{3}He made with high energy and angular resolution allowed us to reconstruct the tetraneutron missing-mass spectra in the two reactions: ^{2}H(^{8}He,^{6}Li)4n and ^{2}H(^{8}He,^{3}He)^{7}H $\rightarrow$ ^{3}H+4n. Both of these approaches showed the evidence for a hump in the 4n continuum at about 3.5 MeV. The applied experimental techniques, the results of the data analysis and simulations are be presented in the report.

In this work we demonstrate that an evidence for the low-energy structures analogous to the observation of [1] can be found in the other reactions with the ^{8}He beam. Such results shed light on the search and spectroscopy of the multineutron system.

1. M. Duer et al., Nature 606 (2022) 678–682.

2. A.S. Fomichev, L.V. Grigorenko, S.A. Krupko, S.V. Stepantsov, G. M. Ter-Akopian, The EPJ A 54 (2018) 97.